

FIGURE 1A

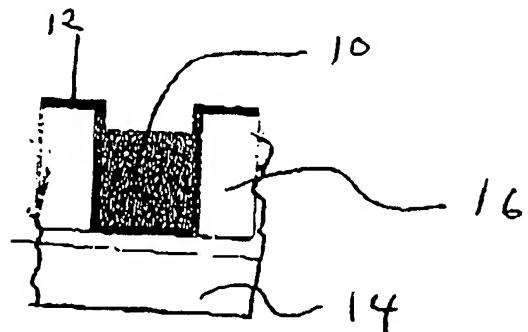


FIGURE 1B

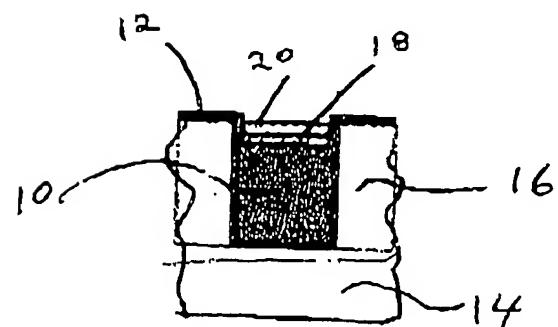


FIGURE 1C

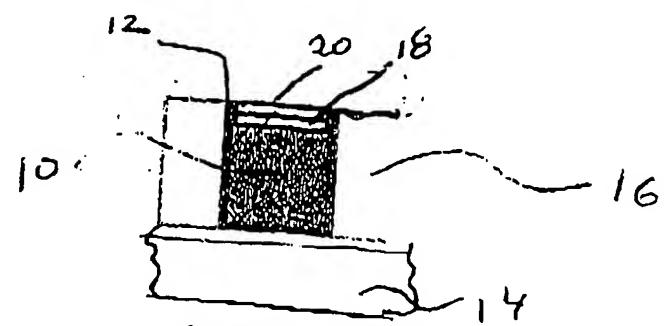


FIGURE 1D

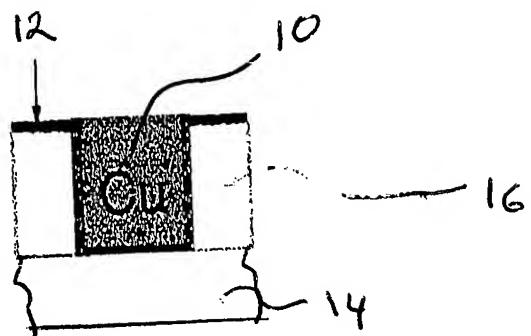


FIGURE 2A

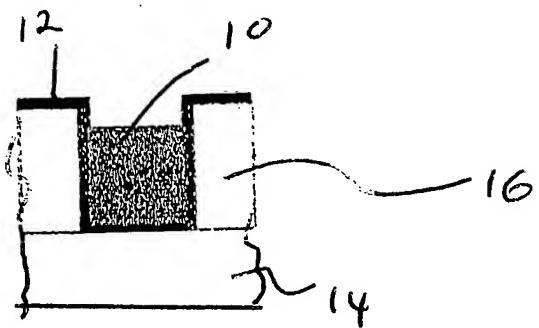


FIGURE 2B

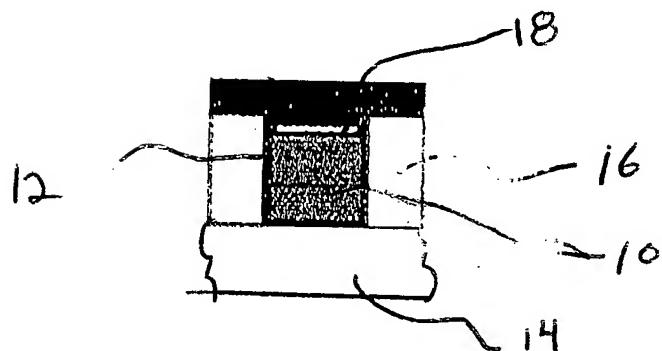


Figure 2C

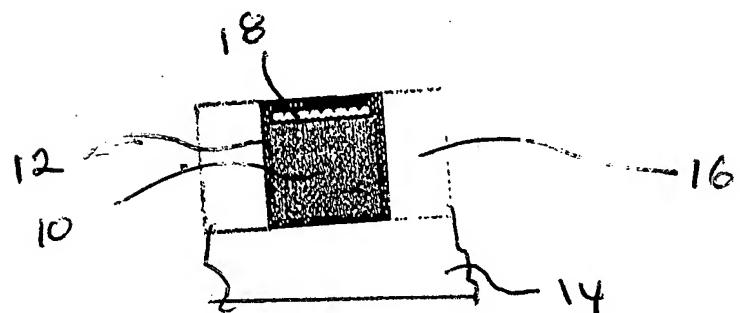


FIGURE 2D

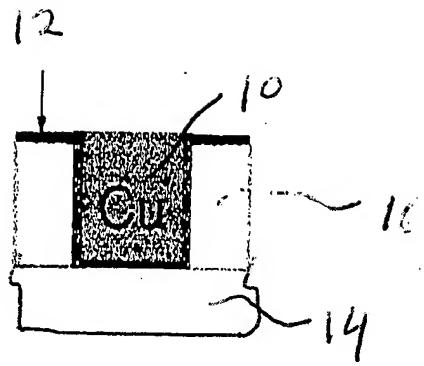


FIGURE 3A

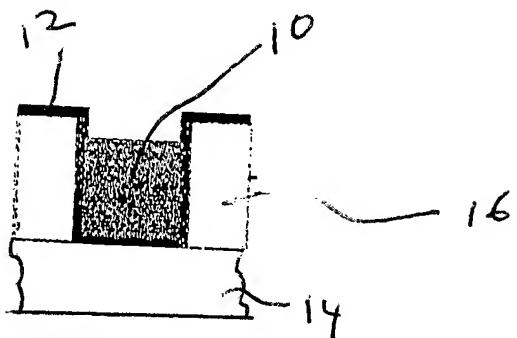


FIGURE 3B

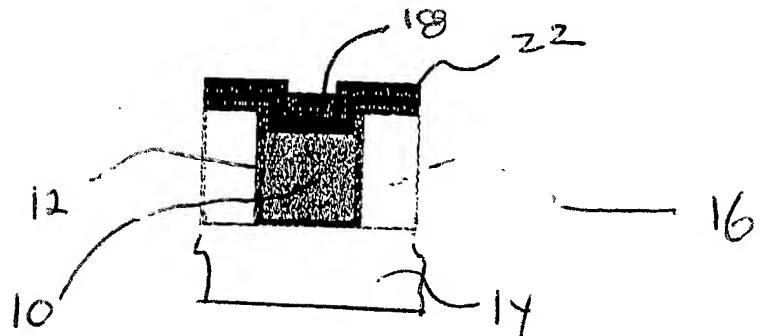


FIGURE 3C

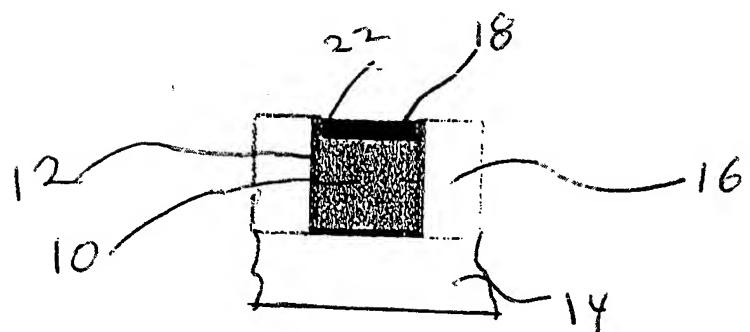


FIGURE 3D

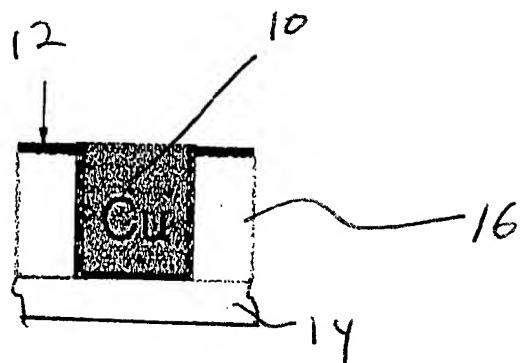


FIGURE 4A

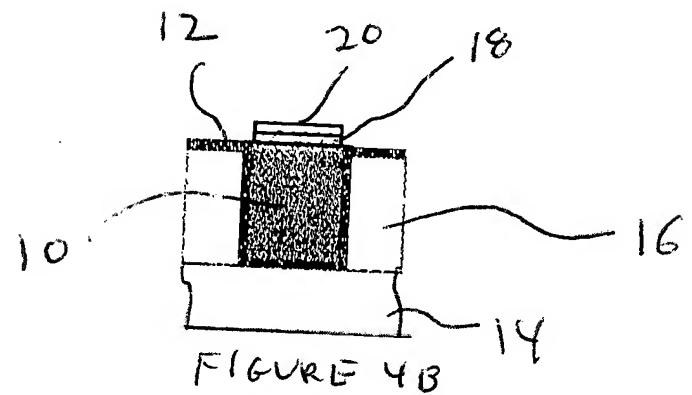


FIGURE 4B

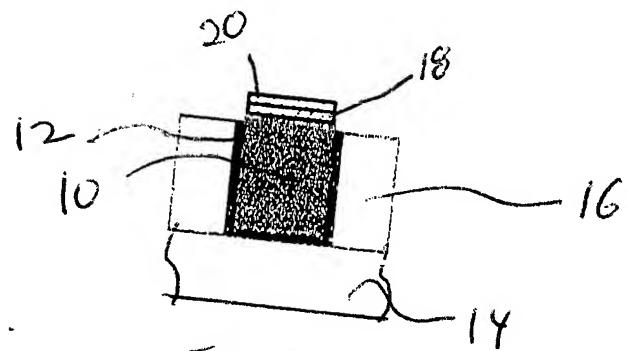
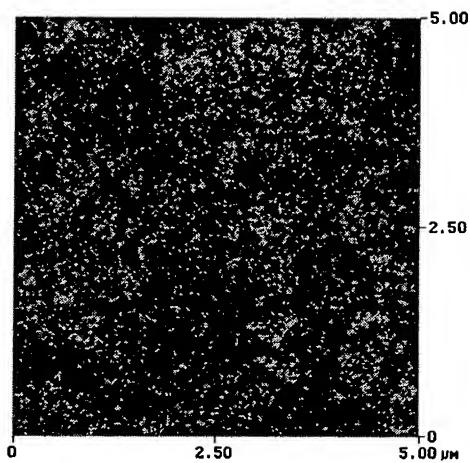
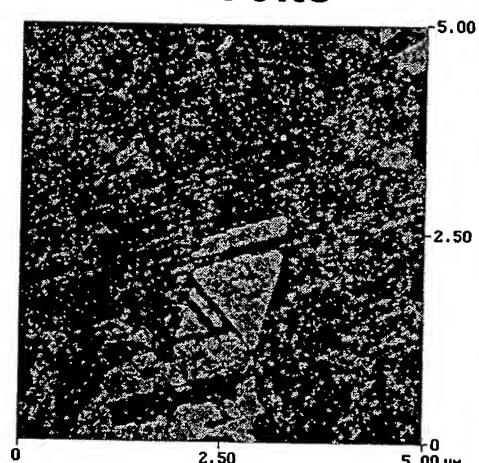


FIGURE 4C

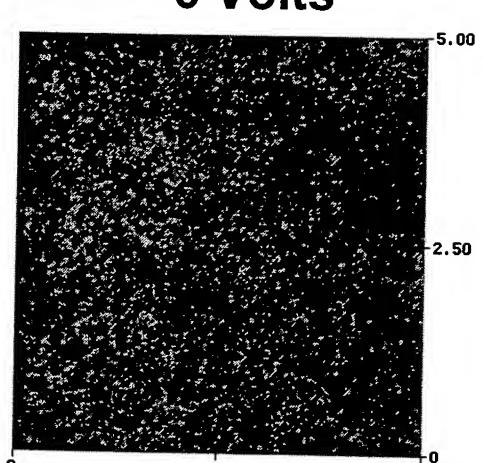
**As Plated**



**4 Volts**



**6 Volts**



Z-range: 35nm  
RMS: 3.3nm

Z-range: 64nm  
RMS: 4.9nm

Z-range: 33nm  
RMS: 3.6nm

FIGURE 5A

FIGURE 5B

FIGURE 5C

Figure 5. AFM images of Cu in the as-plated condition (left) and electroetched at 4V (middle) and 6V (right); the 6V condition replicates the as-plated features; etching at 4V induces increased roughness probably as the result of crystallographic etching.

Figure 6 SEM cross sections of dual damascene structures with the copper selectively electroetched.

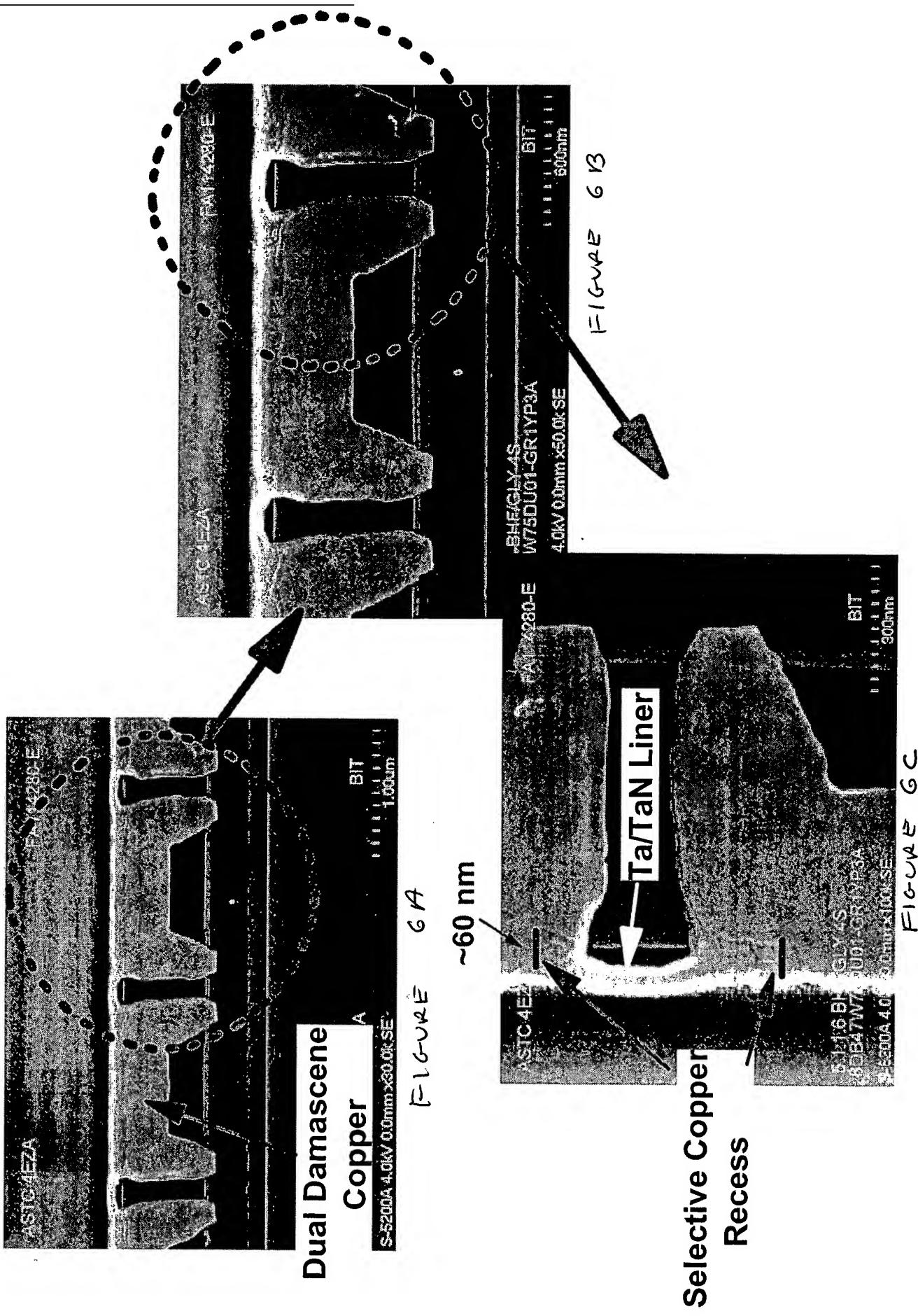


Figure 7. Selectively electroplated Ru (35 nm) inside Cu recess created by selective electropolishing.

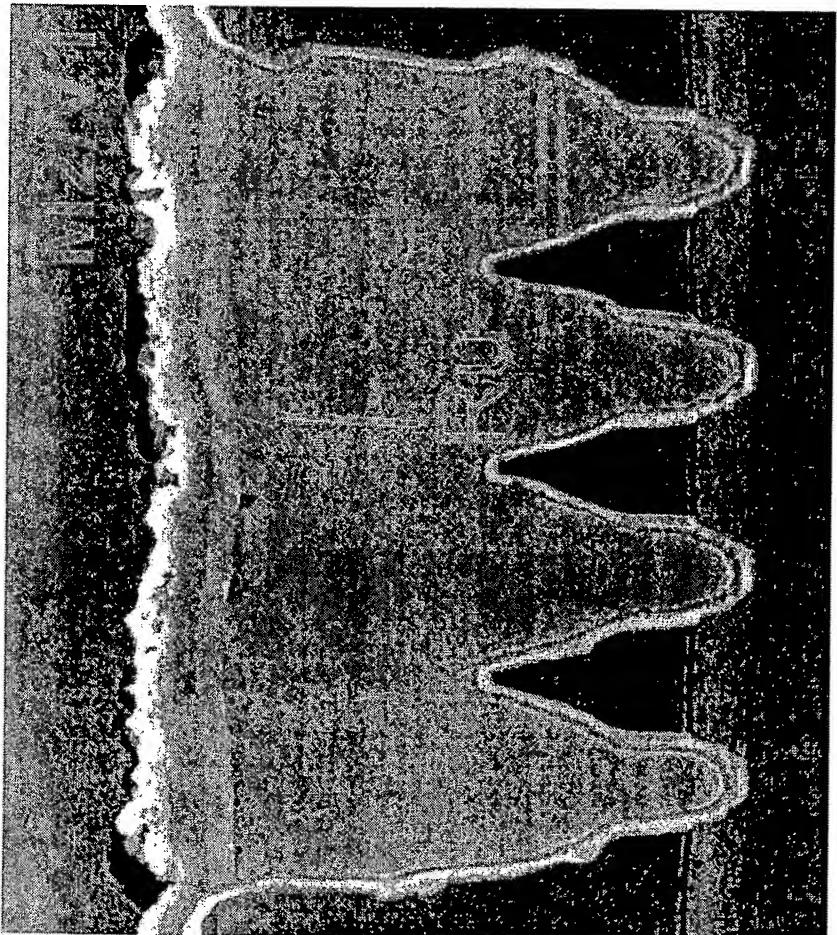


FIGURE 7

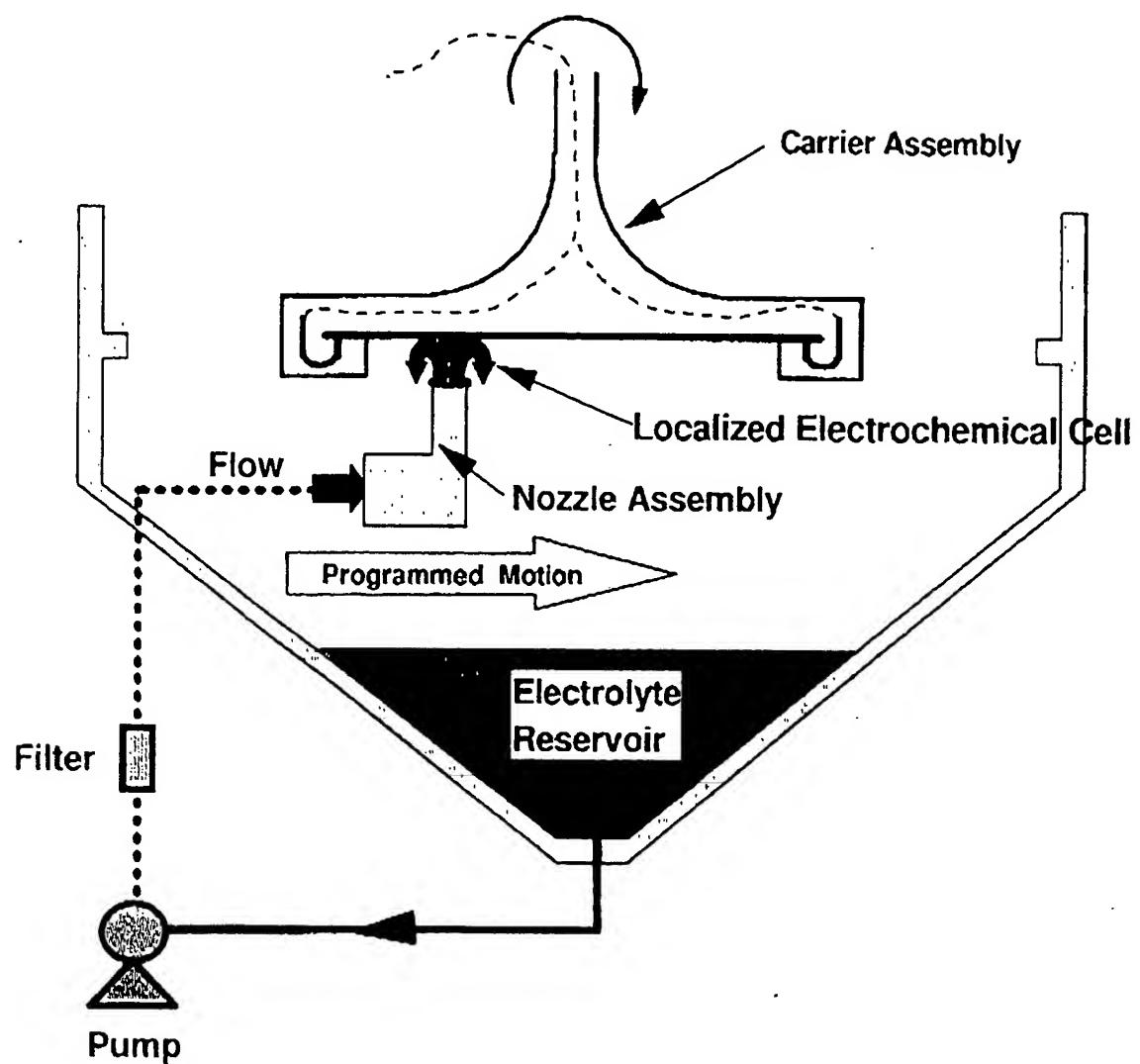


Figure 8 Tool for Cu recess by selective electroetching/etching and for backfill by electrolytic/electroless plating that overcomes the terminal effect by localizing the electrochemistry and by programming of the nozzle motion.

## Manifold Electrode

Figure 9a:  
Cross section view

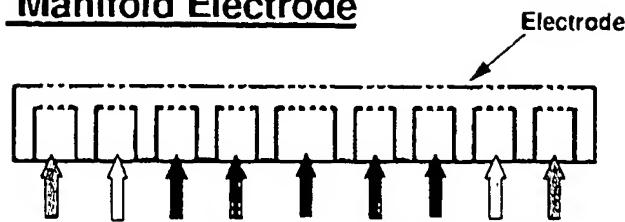


Figure 9b:  
Backside view

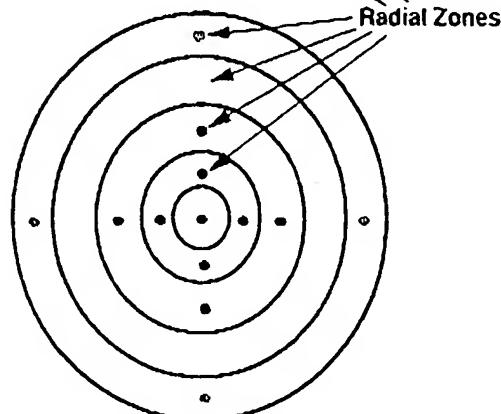


Figure 9c:  
Localized Flow Illustration

